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ABSTRACT

For more than a decade it has been convention to assume that senile dementia Alzheimer's type (SDAT) and Alzheimer's disease early onset represent a unitary disease process with only an onset difference. This assumption has been neither confirmed nor disconfirmed. To address this issue, a study was conducted which analyzed the dissolution of thought in SDAT and in Alzheimer's disease early onset. Subjects were 25 elderly adults with SDAT, 14 adults with Alzheimer's disease early onset, and 25 normal elderly adults who provided a measurement baseline. The SDAT group had an age range of 63-91 years, the normal elderly had an age range of 65-95 years, and the early onset adults had an age range of 44-60 years. The measures for level of thought processing were based on Piaget's universal, unilinear, hierarchical, structural stages of development of thought. Subjects were administered five tests for concrete operational thought. Analysis of quantitative and qualitative data suggests that, although Alzheimer's disease early onset is similar to SDAT in its fundamental pattern of dissolution of thought, the early onset syndrome is dissimilar in that it is characterized by an acceleration of the rate of dissolution found in SDAT. (NB)

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Operational Thought In Alzheimer's Disease Early Onset And SDAT

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RUNNING HEAD: OPERATIONAL THOUGHT
ALZHEIMER'S DISEASE EARLY ONSET
SENILE DEMENTIA ALZHEIMER'S TYPE

SYNOPSIS

For more than a decade it has been convention to assume that senile dementia Alzheimer's type and Alzheimer's disease early onset represent a unitary disease process with only an onset difference. This assumption has been neither confirmed nor disconfirmed. The following paper addresses this issue in the context of an analysis of the dissolution of thought in senile dementia Alzheimer's type and Alzheimer's disease early onset. Quantitative and qualitative data are analyzed from 14 individuals having Alzheimer's type. It is concluded that although Alzheimer's disease early onset is similar to senile dementia Alzheimer's type in its fundamental pattern of dissolution of thought, the early onset syndrome is dissimilar in that it is characterized by an acceleration of the rate of dissolution found in senile dementia Alzheimer's type.

OPERATIONAL THOUGHT IN ALZHEIMER'S DISEASE EARLY ONSET AND SDAT

Olga B. Emery, Ph.D. and Lawrence Breslau, M.D.

The study to be presented will compare systematically Alzheimer's disease early onset with senile dementia Alzheimer's type (SDAT) on the parameter of thought processing. A demographically matched normal elderly population serves to establish baseline measurements. Although it has been convention for somewhat more than a decade to assume that senile dementia Alzheimer's type and Alzheimer's disease early onset represent a unitary disease process with only an onset difference, this assumption has been neither confirmed nor disconfirmed systematically. This issue is in focus in the following comparisons of the two onset populations on measures of the higher order cortical process of thought. The null and alternate hypotheses addressed are - there are not/are significant quantitative and qualitative differences in thought processing between SDAT and Alzheimer's disease early onset.

Fundamental to Alzheimer's disease, both onsets, is the dissolution of cognitive functions. Since dissolution of cognitive activities is at the core of the Alzheimer dementing process, understanding of this progressive disease requires systematic data pertaining to the disintegration of cognitive processing.

Language, memory, and thought are cognitive processes. Although there has been a focus on the memory deficit in Alzheimer disease, late and early onsets, for a long period of years,[1-7] and while there has emerged recently an interest in the language deficit of Alzheimer's disease,[8-17] systematic data relating to the decrement of thought in Alzheimer's disease are virtually non-existent. Alzheimer research appears not to have focused as yet upon the synthetic process of thought. With the exception of less than a handful of studies,[18-19] structural analyses of the deficit of thought in Alzheimer's disease are not to be found. What few other studies there are seem to be limited to global mental status evaluations or WAIS assessment[20,21] rather than structural stage-specific measures of operational thought.[22] And yet thought is the sine qua non of normative human experience. With this research need in mind, we investigated thought processing in SDAT and in Alzheimer's disease early onset.

METHODS

The research comparison groups consisted of 25 elderly adults with senile dementia Alzheimer's type and 14 adults with Alzheimer's disease early onset. A comparison population of 25 normal elderly adults provided a measurement baseline. Age range and age mean were controlled with the SDAT group having an age range of 65-91 with an age mean of 78, and the normal elderly having an age range of 65-93 with an age mean of 81. The age range of the Alzheimer early onset sample is 44-60, with a mean age of

56. Variables of race and sex were controlled. Life span methodologists point out that research relating to higher cortical functions in the elderly is confounded often by cohort differences such as education. Thus the variable of education was controlled rigorously. Native birth, native language of subject, native birth and native language of subject, native birth and native language of subject's parents were controlled also, as were the variables of literate socialization[23] and reading habits. Additionally, occupation was controlled.

Research participants with SDAT were selected from a population of patients having been first diagnosed at age 65 or more, while Alzheimer early cases were first diagnosed prior to age 60. Such patients had their source in one of two university medical complexes and/or university hospital systems; one university medical complex is located in Northern New England, the other is located in the metropolitan Midwest. Excluded from the Alzheimer samples were persons with multi-infarct history and/or CVD, cardio-vascular abnormality of any kind, space-occupying tumors, endocrine or metabolic disease, neurological disease, history of substance abuse. Further, a history of insidious onset was required for diagnosis.[24] All persons accepted for the SDAT and Alzheimer early onset samples underwent a Dementia Workup which included the testing of blood pressure, pulse rate, temperature, respiration, CBC, urine, b_{12}-folic acid, blood sugar, BUN, creatinine, thyroid function, VDRL, FTA/ABS, calcium/phosphorus,

liver enzymes, chest x-ray, reflexes, gait and other neurological variables, EKG, EEG, CT scan. Subjects were required to have ischemic scores of less than 3.[25] In selecting Alzheimer participants, especially those with SDAT, it was critical not to include elderly persons whose cognitive impairment had its origin in depression; it was important not to confound SDAT with a syndrome referred to as pseudodementia for the past fifteen years;[26,27] a syndrome most recently referred to as Type II Cognitive-Depression Disorder by Reifler[28] or termed Depressive Disorder Cognitive Type by the Dementia Workup in combination with the Hamilton Depression Scale, Langner Depression Scale, Geriatric Depression Scale, Kahn-Kodish-Emery Interview for Psychosis, Kahn-Goldfarb Mental Status Questionnaire, Face-Hand Test[29] as well as onset history, previous psychiatric history, and extended medical history. Severity was determined by the Dementia Workup, Reisberg Brief Cognitive Rating Scale, Kahn-Goldfarb Mental Status Questionnaire, and Face-Hand Test. Further, the variable of institutionalization was controlled because of the confounding interaction between variables of extended institutionalization and cognitive impairment.[12]

Normal elderly persons were obtained from the community-at-large. Sample selection of optimally healthy elderly persons was faciliated by several referring physicians who were acquainted with healthy elderly persons. The normal elderly sample was limited to persons who were healthy, both physically and

mentally. Determinants of health included a history of good health, lack of chronic illness, self-sufficiency in everyday function. Blood pressure readings were required to be within normal limits. Only persons without compromised major organ systems were included as participants.

COGNITIVE MEASURES/THOUGHT

The measures for level of thought processing were based on Piaget's universal, unilinear, hierarchial, structural stages of development of thought. Piaget found that the development of thought involves an evolution through four qualitatively distinct stages: sensori-motor (about ages 0-2), pre-operations (ages 2-6), concrete operations (ages 6-12), and formal operations (attained during adolescence when attained at all).[22] Each stage represents a differing level of thought, and thus, a differing capacity for performance on stage-related tasks. In the Piagetian framework, thought is a form of biological adaptation with the two invariant functions of organization and adaptation. Adaptation consists of sub-processes of accommodation and assimilation. Thus, an individual's adaptation is circumscribed by his operational level of thought; and the individual's organismic integrity and organization are indicated by the operational level of thought processing. This is of importance for the Alzheimer patients tested because their level of adaptation and organization is dependent upon and limited by their structural level of operational thought. These concepts, then, form the logical basis for the

research being described in this paper. The Piagetian system provides a structural hierarchy of stages by which to assess the thought processing of the study participants.

We will outline briefly the four stages now, and then describe the tests administered to study participants. The sensori-motor stage is represented by the sensori-motor actions of the organism. Thought is not yet symbolic at the early phase of this least differentiated stage of thought. The pre-operational level is the next stage of the hierarchy, and the stage at which study participants were tested. The stage of concrete opations has been found to be universally consolidated between ages of 6 and 12, and thus represents a reasonable task for any adult. Conservation, the ability to conserve mumbers, liquids, mass, and area, is at the core of the concrete operational level of thought, as is the capability to form classes or for true class inclusion. Unlike the formal operational stage of the hierarchy, the last stage which is characterized by hypothetico-deductive operations, concrete operational thought is not dependent upon educational exposure.[30,32] Therefore, it is a fair expectation that any and all adults would be capable of concrete operational tasks during adulthood unless, for some reason, they have lost the capacity which was consolidated during childhood as an inevitable and natural part of the development of thought.

Five tests for concrete operational thought were administered to study participants: (1) Conservation of mass was tested using

two round balls of playdough equal in size which were placed before the subject. After agreement was attained that the balls were equal in size, the interviewer rolled one of the balls into an elongated shape, and asked the subject if one or the other shapes had more playdough, or if both were equal in amount. (2) Conservation of liquid was tested by the presentation to the subject of two equal sized beakers filled with equal amounts of water, after which one of the beakers was poured into a very differently shaped beaker, and the subject was asked which of the beakers had more water, or if both had the same amount. (3) conservation of area was tested using the same principles as the foregoing, except that the test involved two green areas identified to the participants as grass, and after equal but different dislocations, the subject was asked whehter the amount of grass in each area was different or the same. (4) Conservation of number was tested by lining up ten round wooden beads so that there were two lines of five identical beads side by side. Then, one of the two lines was extended by putting more space between the five beads, and the participant was asked which line had the greater number of beads in it, or if both had the same number. (5) Classification capability was tested by placing fifteen identically shaped wooden beads in front of the subject. The subject was told that all the beads were wooden. Additionally, the fact that all beads were wooden clearly was visible from inspection. Ten of the beads were red in color, and 5 were white in color. The

participant was asked whether there were more wooden beads or red beads.

RESULTS

Using the Difference of Means Test and Student's t-values for determining statistical significance, the data show the following.

The group mean for the twenty-five normal elderly persons was 2.9 out of a maximal possibility of 5, with a standard deviation of 1.37. In other words, the normal elderly as a group correctly processed 2.9 tasks out of 5. Out of a possibility of 125 correct responses (25 subjects times 5 tasks), the normal elderly gave 72 correct answers and 53 incorrect answers. Only two normal elderly participants got all five concrete operational tasks right. Four incorrect responses were given on the conservation of liquid task, six incorrect responses on the conservation of number, eight mistakes on conservation of mass. Twenty normal elderly persons gave an incorrect answer to the conservation of area question, while fifteen normal elderly stated, with relative certitude, that there were more red beads than wooden beads, even though they had been told that all the beads were wooden. Thus, three-fifths of the normal elderly sample showed pre-operational thinking in relation to the class inclusion question. In previous work, we have shown that twenty healthy pre-middle-aged person, with a mean age of 36, averaged 4.5 out of 5 concrete operational tasks as a group.[10,12,32] In these data, it was shown that sixteen out of twenty normal pre-middle-aged persons promptly answered the

identical class inclusion question correctly. The difference of means in performance on all five tasks between the twenty-five normal elderly and the twenty normal pre-middle-aged is statistically significant at the .001 level.

This same age function in concrete operational thought decrement is in evidence again when one divides the normal elderly sample into a younger half (mean age = 73.97) and an older half (mean age = 87.08). The younger half as a group correctly processed 3.56 tasks out of 5, whereas the older half processed 2.2 tasks out of 5; the difference yields a statistical significance of .05. Thus, one sees in these data that there is an inverse correlation between age and good performance on concrete operational tasks in the normal elderly.

The group mean of the twenty-five persons comprising the SDAT sample was .96 tasks correctly processed out of 5. No person in the SDAT group got all five tasks right; nor did any individual get four correct. Four people got three tasks right, while another four people got two tasks right. Four SDAT elderly processed one task, and thirteen SDAT elderly were unable to answer correctly any concrete operational question. Thus, out of a possible 125 responses (25 subjects times 5 questions), the SDAT group correctly answered 24 questions and incorrectly responded to 101 questions. The sample total of 24 correct responses were concentrated in the three simplest tasks of concrete operational thinking (conservation of number, liquids, mass) as opposed to the slightly more difficult

tasks (conservation of area, true class inclusion) which appear to be developmentally consolidated somewhat later.[33] Four persons correctly answered all three questions of conservation of liquids, number, mass, while another three persons correctly answered the two questions of conservation of number and liquids. Another person correctly processed the two questions of conservation of liquids and mass. Finally, three persons each got one item right, answering either the question relating to conservation of number or liquids, while a fourth person correctly answered only the question pertaining to conservation of area. The difference of means between the normal elderly sample (2.9) and the SDAT elderly sample (.96) results in a satistically significant level of .001.

The group mean for the Alzheimer early onset sample was .79 our of 5 tasks. Two persons correctly answered three questions, one person answered two questions, and three people answered one question each. Eight persons in the Alzheimer early onset sample were unable to process a single concrete operational question correctly. Thus, out of a possibility of 70 correct answers (14 persons times 5 tasks), there were 11 correct responses and 59 incorrect responses. The difference of means between the Alzheimer early onset sample (.79) and the SDAT sample (.96) does not constitute a statistically significant difference. Thus on the quantitative parameter, the null hypothesis, that there is no significant difference between the two populations, holds. In terms of quantified performance, the fourteen persons with

Alzheimer's disease early onset and the twenty-five persons with senile dementia Alzheimer's type statistically belong to the same population.

Furthermore, the correct answers of the Alzheimer early onset group were concentrated in the three simplest tasks of concrete operational thought, as were the correct answers of the SDAT group. Thus, the inverse relationship between complexity of task and correct performance, both within and across stages, is found in the data from both Alzheimer onset groups.

As stated above, thirteen of the SDAT sample and eight of the Alzheimer early onset sample were unable to process correctly a single question relating to the concrete operational level of thought. Their responses showed evidence of regression to the pre-operational stage. In the case of five of the SDAT group and four of the Alzheimer early onset group, regression occurred all the way back to the sensori-motor level of thought processing, which is normatively consolidated by two years of age. The responses of these individuals were lacking consensually validated form. Thought processing was neither stable nor constant. Thought was personalized and lacked socially agreed upon definition. Answers to questions related to the patient's immediate desires or to objects immediately present and represented, at best, an associational idiosyncratic relation to the stimulus question. Thus, in both the SDAT sample and the Alzheimer early onset sample, the data show similar decrement in thought processing on the

qualitative variables discussed above, as well as quantitative performance which is similar, thus indicating that the two groups represent a unitary population.

However, a significant difference emerged between the two groups which is of importance. Severity of dementing illness was determined carefully through the multiple measures described in the section on methods. Further, the variable of severity was controlled rigorously across both onset samples; the SDAT sample had seven persons with a composite rating of "mild", five persons who were "moderate", and six persons showing a composite rating of severity, the satistically significant difference which emerges between the two groups involves the variable of duration of time since onset. To attain the same statistical point of decrement in thought, it took the Alzheimer early onset sample a significantly shorter period of time since onset than it did the SDAT sample, indicating that the course of illness progresses faster in Alzheimer's early onset dementing syndrome than in SDAT. The mean number of years of illness from onset for the Alzheimer's early onset sample is 3.07, while the mean number of years from onset for the SDAT sample is 5.64. This difference of means results in a satistically significant alpha of .01 ($t = 2.81$, $df = 37$). It took significantly fewer years for the Alzheimer early onset sample to attain the same state of decrement in thought than it did the SDAT sample.

CONCLUSIONS AND FUTURE DIRECTIONS

The data suggest that although Alzheimer's disease early onset and SDAT would appear to represent the same population on the basis of quantified performance and pattern of decrement in thought, nevertheless, there also appears to be a fundamental difference in that Alzheimer's disease early onset is characterized by a faster progression, a faster deterioration than is SDAT. Put another way, Alzheimer's disease early onset is akin to SDAT in its fundamental pattern, but differs from SDAT in its increased rate of acceleration of the disease process.

Elsewhere we have discussed that there appears to be a normal aging pattern and that SDAT appears to represent a vast acceleration of the normal aging pattern, and that somehow, both normal aging and SDAT probably involve the same chromosomal substrate.[12,19,34] On the basis of the findings presented in our previous work, and on the basis of the data delineated in the foregoing, we have constructed, most tentatively, a model in which Alzheimer's disease early onset, SDAT, and normal aging represent a continuum of acceleration of higher cortical deterioration. In this tentatively proposed model, SDAT is envisioned as a disease process which in its essentials follows the fundamental pattern of normal aging, but represents such a vast acceleration of decrement in synthetic processing, that it must be viewed as outside the boundaries of normal aging possibility; hence it is a disease

process. And then in turn, Alzheimer's disease early onset represents an acceleration of the rate of dissolution found in SDAT. Thus, the model would postulate essentially the same pattern of dissolution for each group, but with a significantly different rate of acceleration which significantly alters the gap between normalcy and disease process.

Future directions for research include reliability and validity checks upon the data presented in the foregoing, or broad scaled nomothetic validation, within the context of the proposed model of the acceleration process of Alzheimer's disease. We are presently investigating the higher cortical processes of thought, language, memory in SDAT and Alzheimer's disease early onset and correlating these findings with biochemical findings and neuropathological findings from the same study participants in a longitudinal study. The longitudinal perspective of intra-individual changes, along with correlated data on cognitive, biochemical, neuropathological parameters from the same study participants, should permit us to hone in on issues addressed in the present discussion.

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TABLE I

COMPARISON OF MEAN NUMBER OF YEARS SINCE ONSET WITH MEAN SCORE ON CONCRETE OPERATIONAL THOUGHT BY SAMPLE

Sample	N	Mean Age	Mean # of Years Illness Since Onset	Mean Score on Concrete Operations
SDAT	25	78	5.64	.96*
ALZHEIMER EARLY ONSET	14	56	3.07	.79*
	t-value		2.81	
	significance level		.01	not significant

N = 39, DF = 37

*Maximal score possible = 5